



Regulatory Update

EPA's Nonroad Engine Emissions Control Programs

In response to environmental and public health concerns, the U.S. Environmental Protection Agency (EPA) has established emission standards for several nonroad engine categories. The categories of nonroad engines currently being addressed by EPA cover a variety of applications, including farm and construction equipment, lawn and garden equipment, marine vessels, and locomotives. As a whole, EPA's nonroad programs will significantly reduce the impact of nonroad equipment on the nation's air quality.

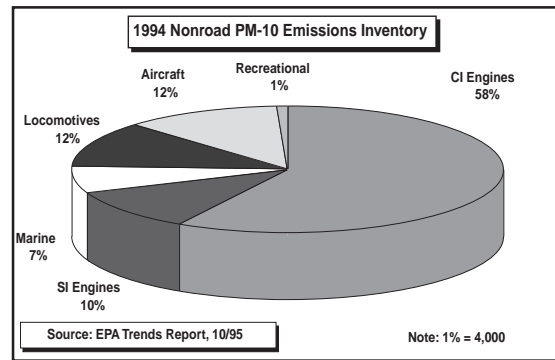
Background

EPA has been regulating highway cars and trucks since the early 1970s and continues to set increasingly stringent standards for such vehicles. After so much progress has been made in controlling the emissions from highway vehicles, EPA turned its attention to nonroad categories of mobile sources, which also contribute significantly to air pollution. These nonroad control programs assist states in complying with the National Ambient Air Quality Standards (NAAQS).

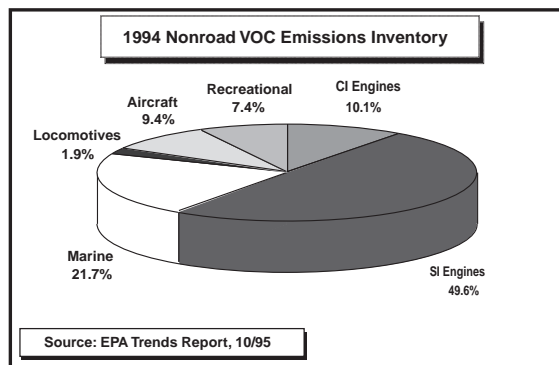
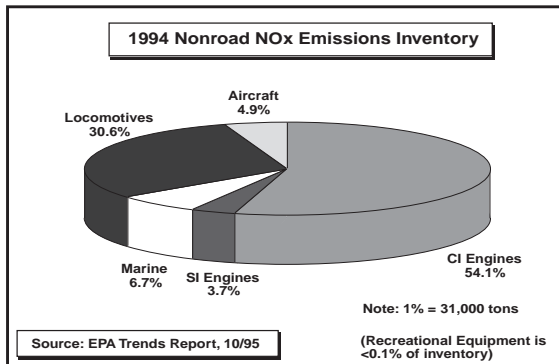
The 1990 Clean Air Act Amendments specifically directed EPA to study the contribution of nonroad engines to urban air pollution, and regulate them if warranted. "Nonroad" is a term that covers a diverse collection of engines, equipment, and vehicles. Also referred to as "off-road" or "off-highway," the nonroad category includes outdoor power equipment, recreational equipment, farm equipment, construction equipment, lawn and garden equipment, and marine vessels. Though dealt with separately

in the Clean Air Act, locomotives and aircraft can also be considered categories of nonroad engines. Except for aircraft, nonroad engines were not regulated by EPA prior to the mid-1990s.

In 1991, EPA released a study documenting emission levels across a broad spectrum of nonroad equipment that were higher than expected. The EPA study showed that emissions from nonroad engines are a significant source of oxides of nitrogen (NO_x), volatile organic compound (VOC), and particulate matter (PM) emissions.



In response, EPA initiated regulatory programs for several categories of nonroad engines. The following sections summarize the status of EPA's regulatory programs for the various nonroad equipment categories.



Land-Based Diesel Engines

Nonroad diesel engines, also referred to as compression-ignition engines, dominate the large nonroad engine market and comprise approximately 25 percent of the current mobile source NO_x emissions inventory and 40 percent of the current mobile source PM emissions inventory. Examples of applications falling into this category include: agricultural equipment such as tractors; construction equipment such as backhoes; material handling equipment such as heavy forklifts; and utility equipment such as generators and pumps.



In some areas of the country, emissions from nonroad engines represent a third of the total mobile source NO_x and VOC inventory and over two-thirds of the mobile source PM inventory.

Under EPA regulations, diesel engines greater than 50 horsepower (hp) must comply with Tier 1 emissions standards that are being phased in between 1996 and 2000, depending on the size of the engine. Under the Tier 1 standards, EPA projects that NOx emissions from new diesel nonroad equipment will be reduced by over 30 percent from uncontrolled levels of unregulated engines. The Tier 1 standards do not apply to engines used in underground mining equipment, locomotives, and marine vessels. (The Mine Safety and Health Administration is responsible for setting requirements for underground mining equipment. Locomotives and marine vessels are covered by separate EPA programs, as described below.)

Examples of CI Equipment

tractors	backhoes
bulldozers	forklifts
generators	pumps

In August 1998, EPA adopted more stringent emission standards for NOx, hydrocarbons (HC), and PM for new nonroad diesel engines, to be phased in over several years beginning in 1999. Engines used in underground mining equipment, locomotives, and marine vessels over 50 hp are not included. This comprehensive new program includes the first set of standards for nonroad diesel engines less than 50 hp to be phased in from 1999 to 2000. It also phases in more stringent Tier 2 standards for all engine sizes from 2001 to 2006, and yet more stringent Tier 3 standards for engines over 50 hp from 2006 to 2008. Finally, the new program includes a voluntary program to encourage the production

of advanced, very-low emitting engines. Under these new standards, EPA projects that emissions from new nonroad diesel equipment will be further reduced by 60 percent for NOx and 40 percent for PM compared to the emission levels of engines meeting the Tier 1 standards.

Small Land-Based Spark-Ignition Engines

Small spark-ignition (SI) engines (e.g., engines operating on gasoline, natural gas, propane, or methanol) at or below 25 hp (19 kilowatts) comprise about 9 percent of the mobile source VOC inventory. These small engines are used primarily in lawn and garden equipment, such as lawn-mowers, string trimmers, edgers, chain saws, commercial turf equipment, and lawn and garden tractors.

Under Phase 1 of EPA's regulations, new small SI engines must comply with emission standards for HC, CO, and NOx beginning in 1997. The Phase 1 standards apply to all SI engines at or below 25 hp, except for those used in aircraft, marine vessels, and recreational equipment. EPA expects that these Phase 1 standards will result in a 32 percent reduction in HC emissions from small SI engines.



Examples of Small SI Equipment

augers	brush cutters
chainsaws	edgers
lawn mowers	tillers
leaf blowers	trimmers

Phase 2 regulations, including more stringent emission levels and new provisions to ensure low in-use emissions, are being developed. The Phase 2 program may reduce combined emissions of HC plus NO_x from these engines by approximately 60 percent beyond Phase 1 levels.

Large Land-Based Spark-Ignition Engines

Spark-ignition engines above 25 hp are currently not regulated by EPA. These engines are used in a variety of industrial equipment, including forklifts, airport ground-service equipment, generators, and compressors. The California Air Resources Board adopted new emission standards for these engines in October 1998. EPA intends to pursue an emission control program for these engines that would extend the California requirements to the rest of the nation. Application of basic automotive emission control technologies to this engine category would reduce NO_x and HC emissions by 70 to 90 percent.

Examples of Large SI Equipment

forklifts
airport ground-service equipment
generators
compressors

Engines used in recreational applications, such as go-carts, all-terrain vehicles, and snowmobiles, are not currently regulated by EPA. EPA intends to pursue appropriate emission standards for these engines.

Marine Engines

Like land-based nonroad engines, marine engines serve a wide variety of applications. The smallest marine engines, virtually all of which use gasoline, are used in recreational outboards and personal watercraft. Small gasoline or diesel marine engines provide auxiliary power on many vessels. Larger marine engines provide propulsion for both recreational and commercial applications. Recreational sterndrive and inboard engines tend to be gasoline, though diesel engines are making inroads into that market.

Commercial engines, virtually all diesel, power vessels such as tugs, ferries, and crew/supply boats. These engines also provide auxiliary power on larger vessels. The largest marine diesel engines, sometimes exceeding 60,000 hp, propel ocean-going vessels. EPA intends to have emission control requirements for all marine engines. Engines are grouped under three control programs reflecting their application and, to some extent, the fuel they use.

Gasoline Outboards and Personal Watercraft Marine Engines

Gasoline outboards and personal watercraft contribute about 5 percent of the national mobile source VOC inventory. However, in areas with large boat populations, the contribution of these recreational marine engines may exceed 10 percent of the regional HC inventory. These engines

typically employ 2-stroke technology, which changed very little over the last 50 years.



Regulations to control exhaust emissions from new outboards and personal watercraft went into effect in July 1996. The emission controls for these engines involve increasingly stringent standards over the course of a nine-year phase-in period beginning in model year 1998. By the end of the phase-in, each manufacturer must meet an emission standard, on a corporate-average basis, that represents a 75 percent reduction in HC compared to unregulated levels. The gradually decreasing emission standard allows manufacturers to determine the best approach to achieving the targeted reductions over time. Manufacturers are able to phase in the types of control technologies in the most sensible way, while minimizing the cost impact to the consumer.

Commercial Diesel Marine Engines

Commercial diesel marine engines contribute about 8 percent of the national mobile source NO_x inventory, and about 1 percent of the national mobile source PM inventory. In areas with large commercial ports or near busy shipping lanes, the contribution of diesel marine engines to the local NO_x and PM inventory may be much higher.

EPA proposed regulations for the control of exhaust emissions from new marine diesel engines in November 1998. The proposed emission limits, which vary depending on the size of the engine, are similar to emission limits for corresponding land-based nonroad or locomotive engines. These limits would apply beginning with engines manufactured in 2004. In addition, a more stringent set of emission limits based on the nonroad Tier 3 approach will be evaluated in 2003. At that time, EPA will confirm the Tier 3 limits or adjust them to reflect the technologies manufacturers can apply at that time. The more stringent Tier 3 emission limits would apply beginning with engines manufactured in 2008.

The proposed emission limits for very large commercial marine diesel engines are the same as those contained in Annex VI of the International Convention on the Prevention of Pollution from Ships (MARPOL). Consistent with MARPOL Annex VI, these proposed limits will apply to engines installed on ships constructed on or after January 1, 2000.

Recreational Sterndrive and Inboard Engines

Recreational sterndrive and inboard engines can be either gasoline or diesel engines. While their contribution to national mobile VOC and NO_x levels is smaller than the other two marine engine categories, their emissions are expected to increase due to the growing number of recreational vessels. EPA did not finalize emission limits for gasoline sterndrive and inboard engines as part of the 1996 marine rule. Likewise, EPA did not propose limits for recreational diesel engines in the commercial diesel engine rule. Conse-

quently, these recreational engines remain unregulated at this time. EPA has started in a separate rulemaking to consider emission limits for these engines however.

Locomotives

Locomotives are estimated to contribute about 9 percent of the nationwide mobile source NO_x emissions inventory. These engines are generally larger and last longer than any land-based nonroad diesel engines. In April 1998, EPA finalized emission standards for NO_x, HC, carbon monoxide (CO), PM, and smoke for locomotives. The new standards are expected to reduce NO_x emissions by two-thirds, while HC and PM emissions from these engines will decrease by 50 percent.



A unique feature of the locomotive program is that it includes emission standards for remanufactured engines, including all those that were originally built since 1973. Regulation of the remanufacturing process is critical because locomotives are generally remanufactured 5 to 10 times during their total service lives, which is typically 40 years or more.

Three separate sets of emission standards have been adopted, with applicability of the standards dependent on the date a locomotive is first manufactured. The first set of standards (Tier 0) apply to locomotives and locomotive engines originally manufactured from 1973 through 2001, any time they are manufactured or remanufactured.

The second set of standards (Tier 1) apply to locomotives and locomotive engines originally manufactured from 2002 through 2004. These locomotives and locomotive engines will be required to meet the Tier 1 standards at the time of original manufacture and at each subsequent remanufacture.

The final set of standards (Tier 2) apply to locomotives and locomotive engines originally manufactured in 2005 and later. Tier 2 locomotives and locomotive engines will be required to meet the applicable standards at the time of original manufacture and at each subsequent remanufacture. Electric locomotives, historic steam-powered locomotives, and locomotives originally manufactured before 1973 do not contribute significantly to the emissions problem and, thus, are not included in this rulemaking.

Aircraft

Aircraft emissions comprise less than 2 percent of the mobile source NO_x emissions inventory, but they are significant contributors to the NO_x inventory in some cities. In addition, commercial aircraft emissions are a fast growing segment of the transportation emissions inventory. Aircraft emissions are potentially important contributors to global climate change and may

also contribute to the depletion of the stratospheric ozone layer.

Emission standards for gas turbine engines that power civil aircraft have been in place for about 20 years. Such engines are used in virtually all commercial aircraft, including both scheduled and freight airlines. The standards do not apply to military or general aviation aircraft. Controls on engine smoke and prohibitions on fuel venting were instituted in 1974 and have been revised several times since then. Beginning in 1984, limits were placed on the amount of unburned HC gas turbine engines can emit per landing and takeoff cycle.



In April 1997, EPA adopted the existing International Civil Aviation Organization (ICAO) NO_x and CO emission standards for gas turbine engines. ICAO, a specialized agency of the United Nations, is the most appropriate forum for first establishing commercial aircraft engine emission standards due to the international nature of the aviation industry.

EPA is also exploring other ways to reduce the environmental effects associated with air travel throughout the nation. EPA is working with the Federal Aviation Administration (FAA) to encourage continuing progress in reducing emissions from airport

ground service equipment and aircraft auxiliary power units. EPA sponsored compilation of technical data and emission inventory methods, which the FAA will use to develop an Advisory Circular for airlines and airport authorities interested in reducing emissions from these sources.

For More Information

Additional documents on nonroad engine programs are available electronically from the EPA Internet server at:

www.epa.gov/oms/nonroad.htm

Document information is also available by writing to:

U.S. Environmental Protection Agency
Office of Mobile Sources
2000 Traverwood Drive
Ann Arbor, Michigan 48105

EPA has additional fact sheets that go into more detail on these nonroad engine control programs:

General:

- *Emission Standards Reference Guide for Heavy-Duty and Nonroad Engines*, October 1997: map format (EPA420-F-97-014); poster (EPA420-H-97-001).
- *Nonroad Engines and Air Pollution* (EPA420-F-94-003), May 1996.

Land-Based Diesel Engines:

- *New Emission Standards for Nonroad Diesel Engines* (EPA420-F-98-034), August 1998.

- *Notice of Proposed Rulemaking: Nonroad Diesel Engine Emissions* (EPA420-F-97-020), October 1997.
- *Statement of Principles for Nonroad Diesel Engines* (EPA420-F-96-015), September 1996.

Small Land-Based Spark-Ignition Engines:

- *Small Engine Emission Standards—Answers to Commonly Asked Questions from Dealers and Distributors* (EPA420-F-98-025), September 1998.
- *Proposed Phase 2 Standards for Small Spark-Ignited Engines* (EPA420-F-97-045), December 1997.
- *Nonroad Phase 2 Small Spark-Ignited Engines Advance Notice of Proposed Rulemaking* (EPA420-F-97-001), March 1997.
- *Statement of Principles for Small Nonhandheld Spark-Ignited Engines* (EPA420-F-97-002), January 1997.
- *Statement of Principles for Small Handheld Gasoline Engines* (EPA420-F-96-001), May 1996.
- *Be a Grower, Not a Mower* (EPA420-F-96-018), April 1997.

Large Land-Based Spark-Ignition Engines:

- *Proposed Finding on Emission Standards for New Large Spark-Ignition Nonroad Engines* (EPA420-F-99-004), January 1999.

Marine Engines:

- *Proposed Emission Standards for New CI Marine Engines* (EPA420-F-98-044), November 1998.
- *Advance Proposal for Emission Standards for New Diesel Marine Engines* (EPA420-F-98-006), May 1998.
- *Emission Standards for New Gasoline Marine Engines* (EPA420-F-96-012), August 1996.
- *Emission Standards for New Spark-Ignition Marine Engines: Information for the Marine Industry* (EPA420-F-96-013), August 1996.
- *Boating Pollution Prevention Tips* (EPA420-F-96-003), July 1996.

Locomotives:

- *Final Emission Standards for Locomotives* (EPA420-F-97-048), December 1997.
- *Federal Preemption of State and Local Control of Locomotives* (EPA420-F-97-050), December 1997.
- *Environmental Benefits of Emission Standards for Locomotives* (EPA420-F-97-049), December 1997.
- *Emission Factors of Locomotives* (EPA420-F-97-051), December 1997.

Aircraft:

- *Adopted Aircraft Engine Emission Standards* (EPA420-F-97-010), April 1997.